

FIG.1

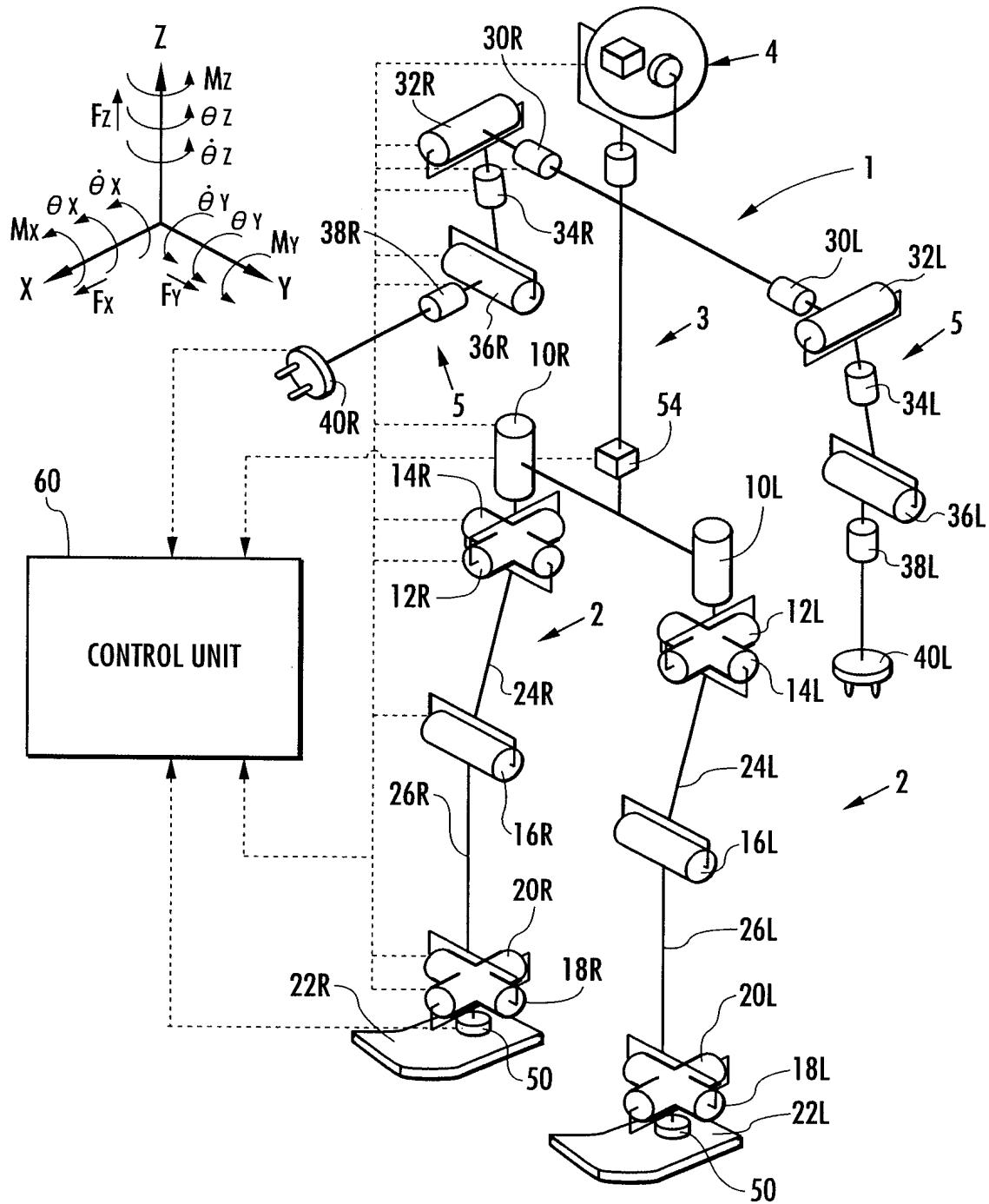


FIG.2

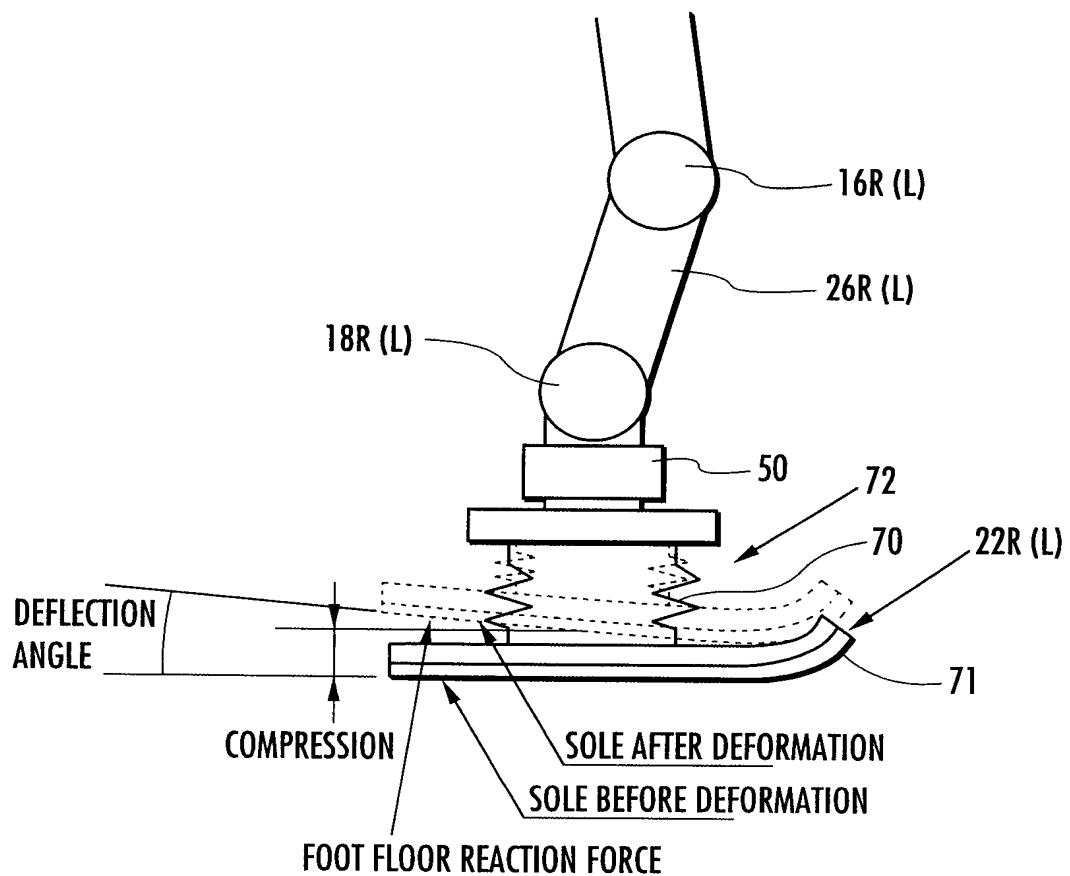


FIG.3

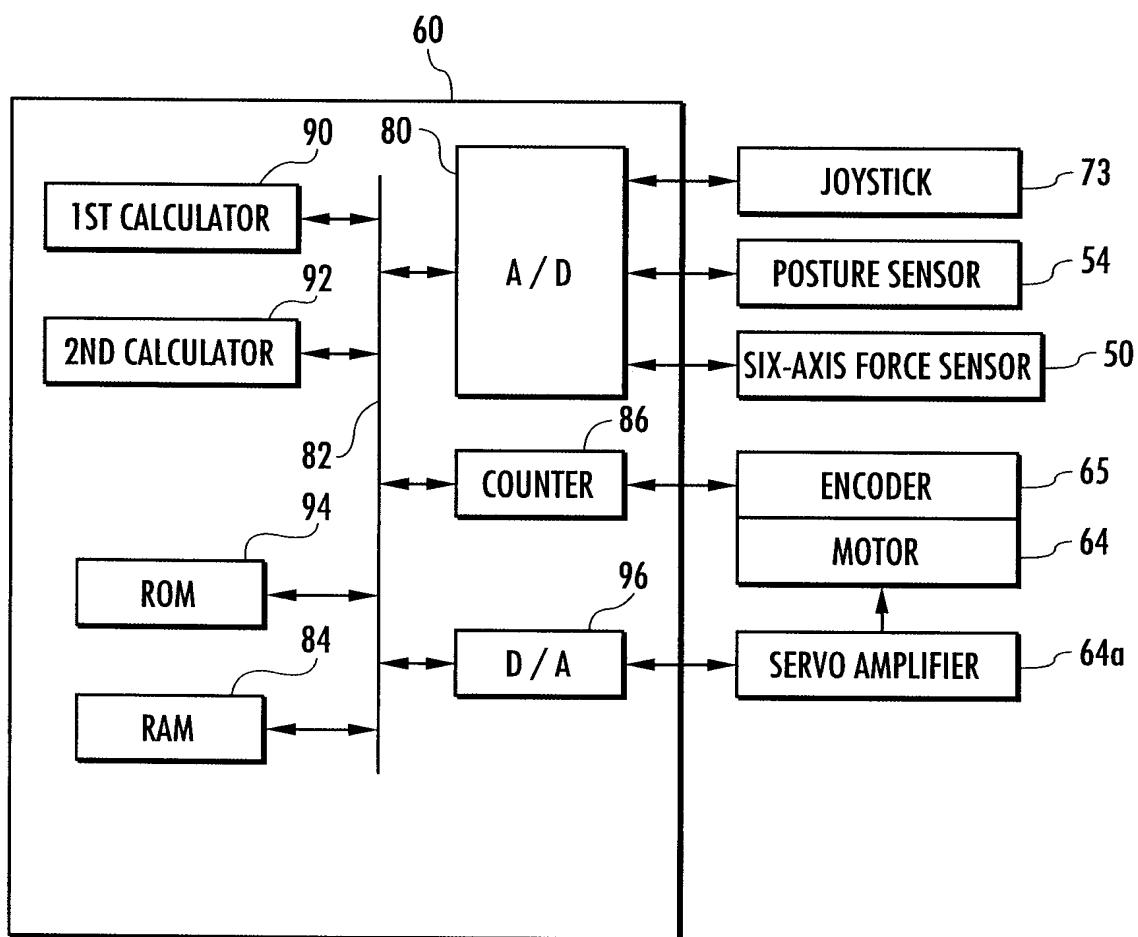


FIG. 4

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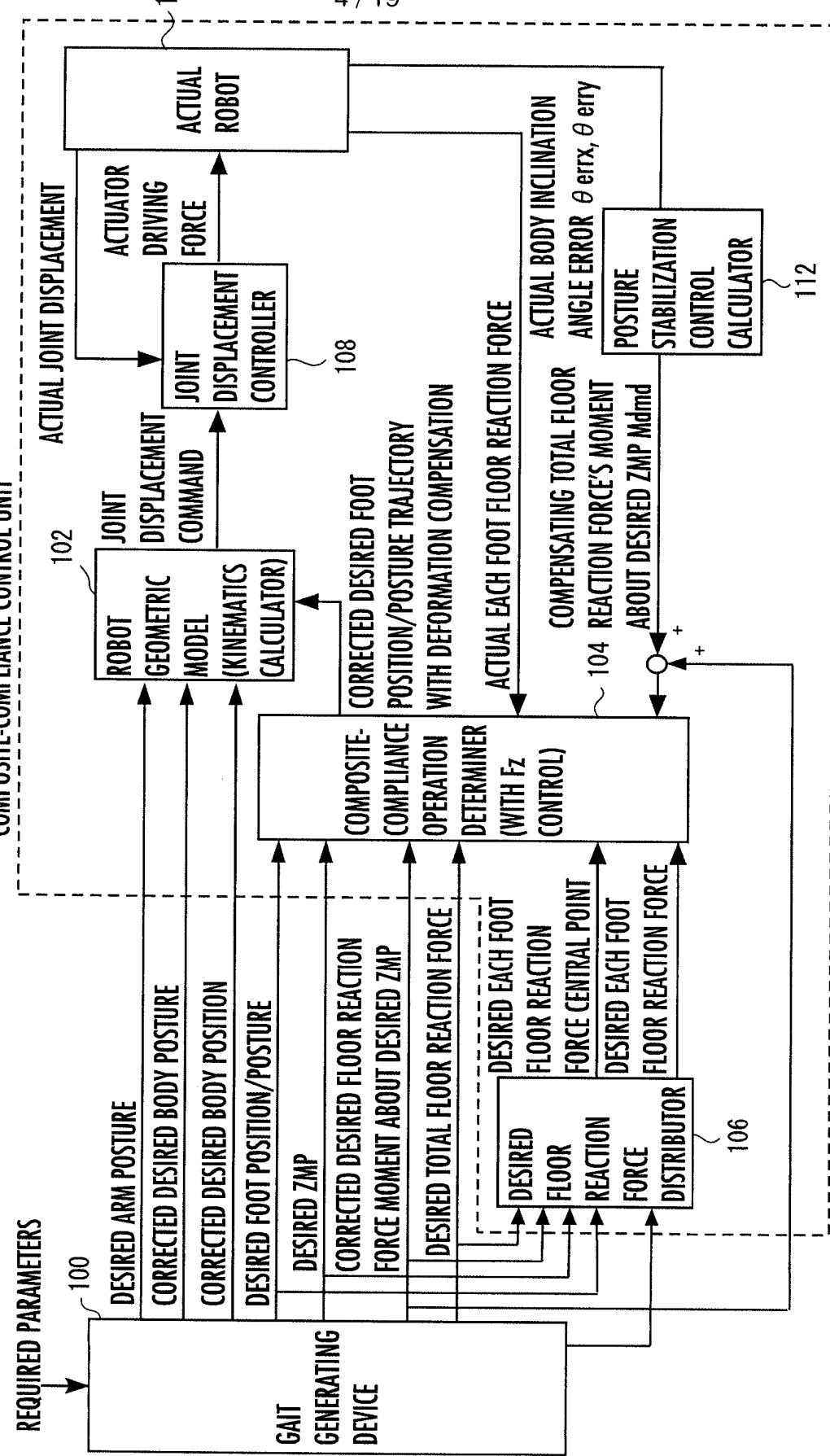


FIG. 5

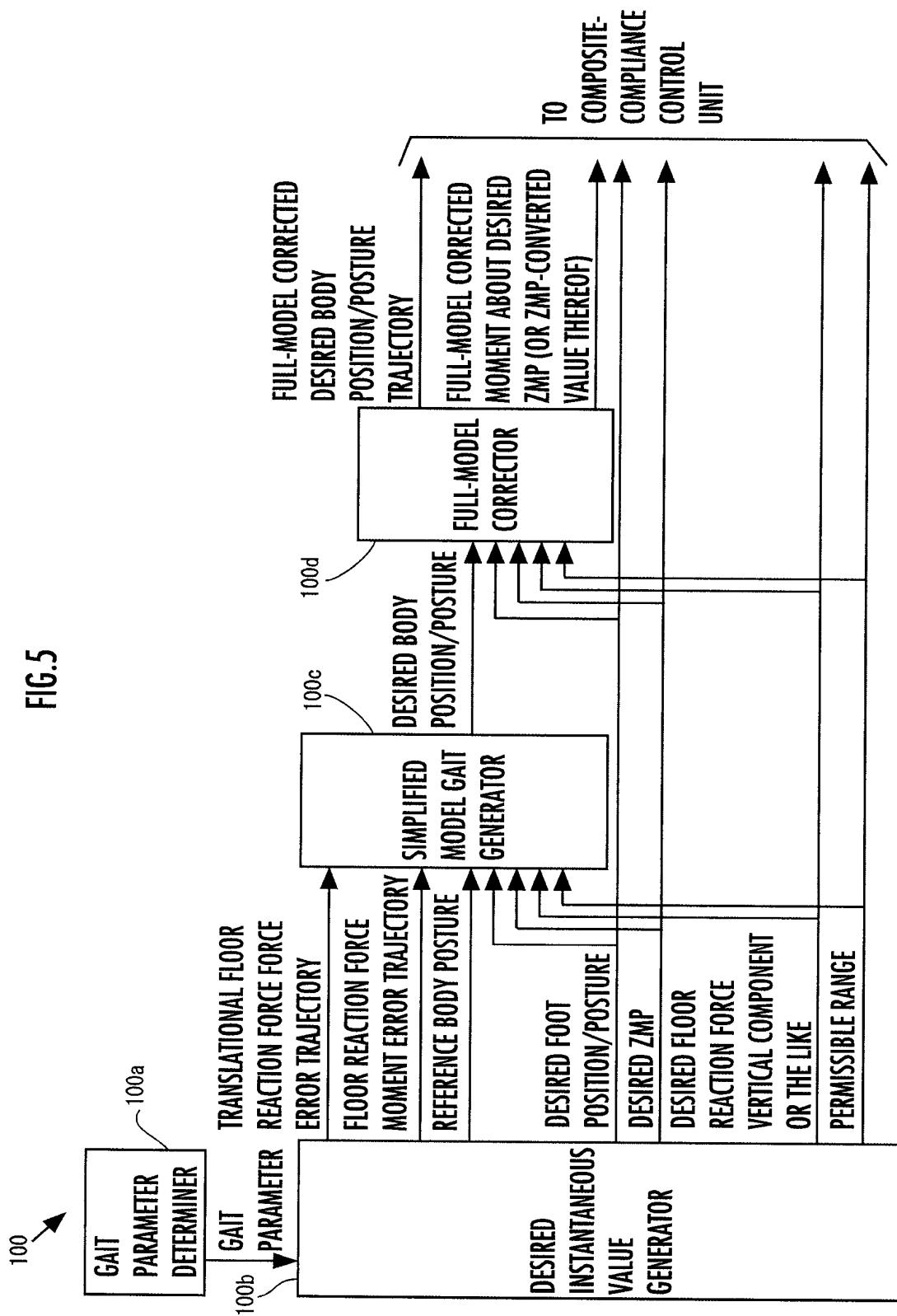


FIG.6(a)

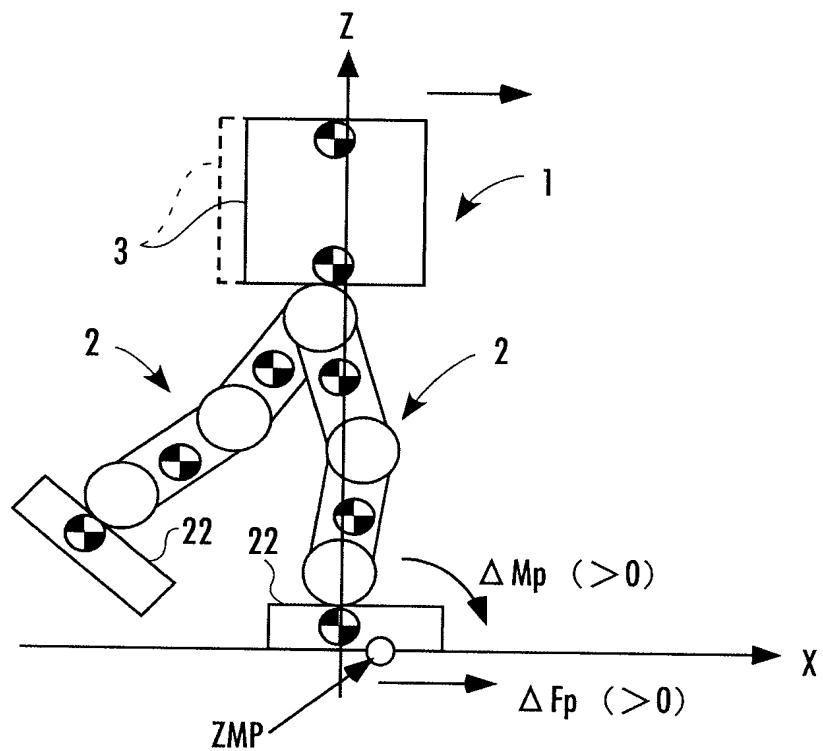


FIG.6(b)

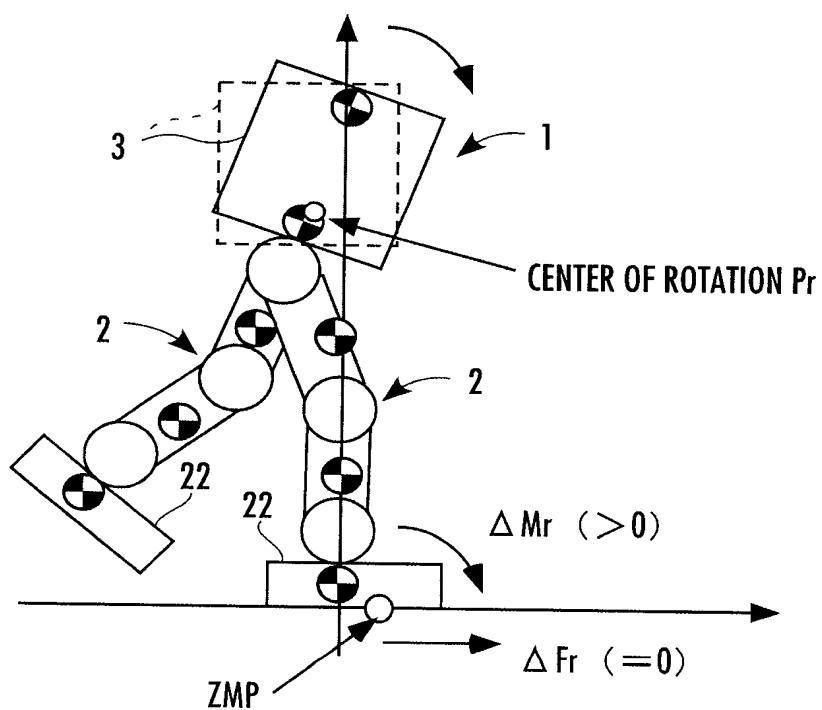


FIG.7

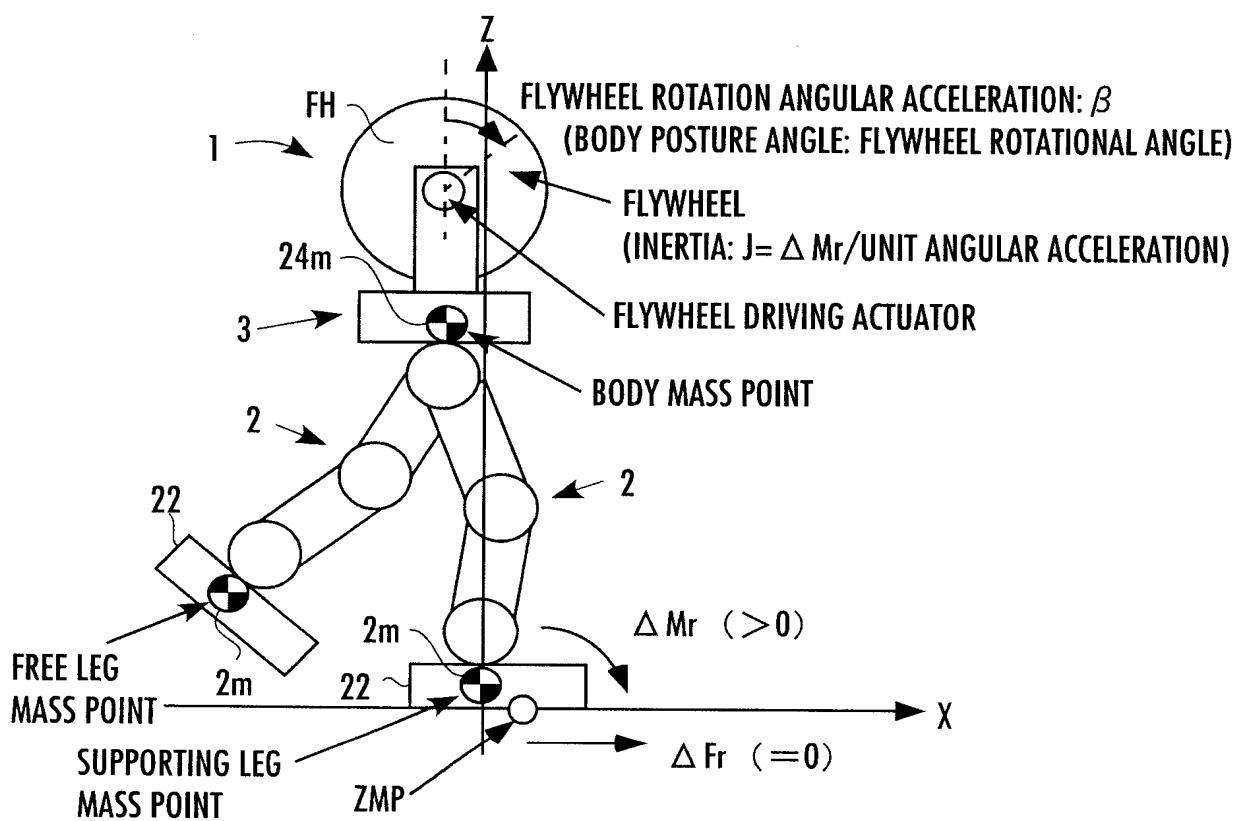


FIG.8

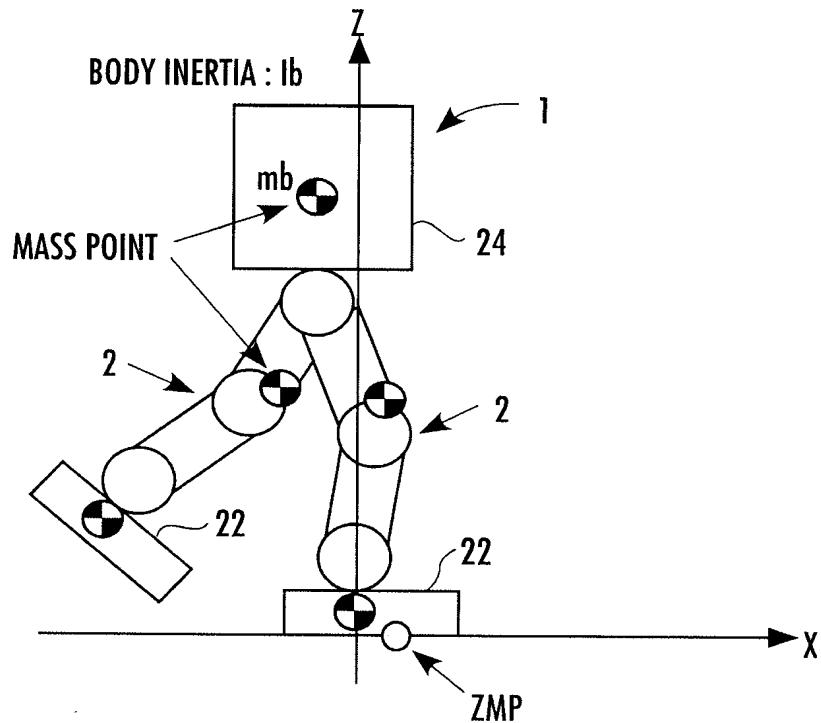


FIG.9

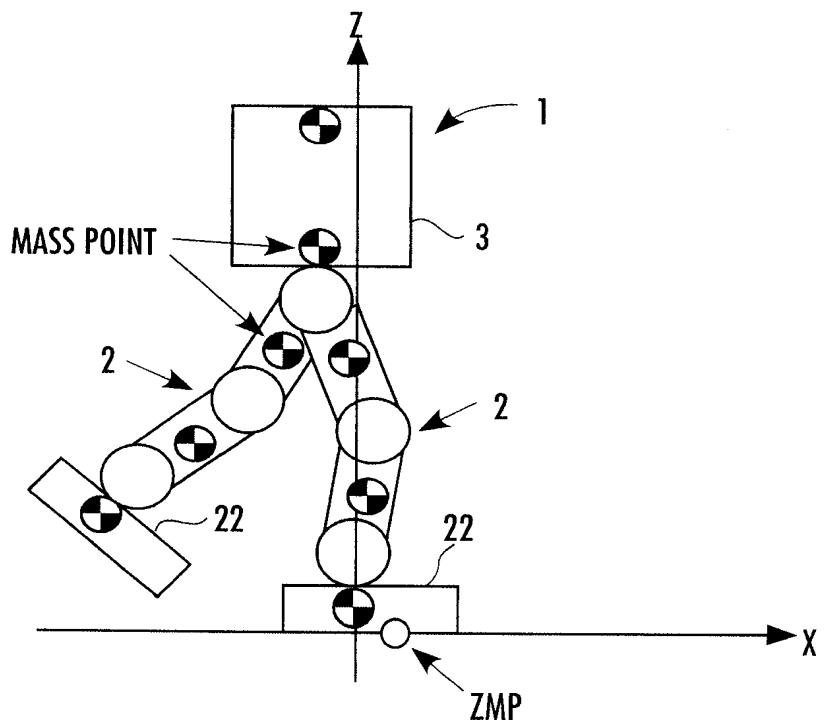


FIG.10

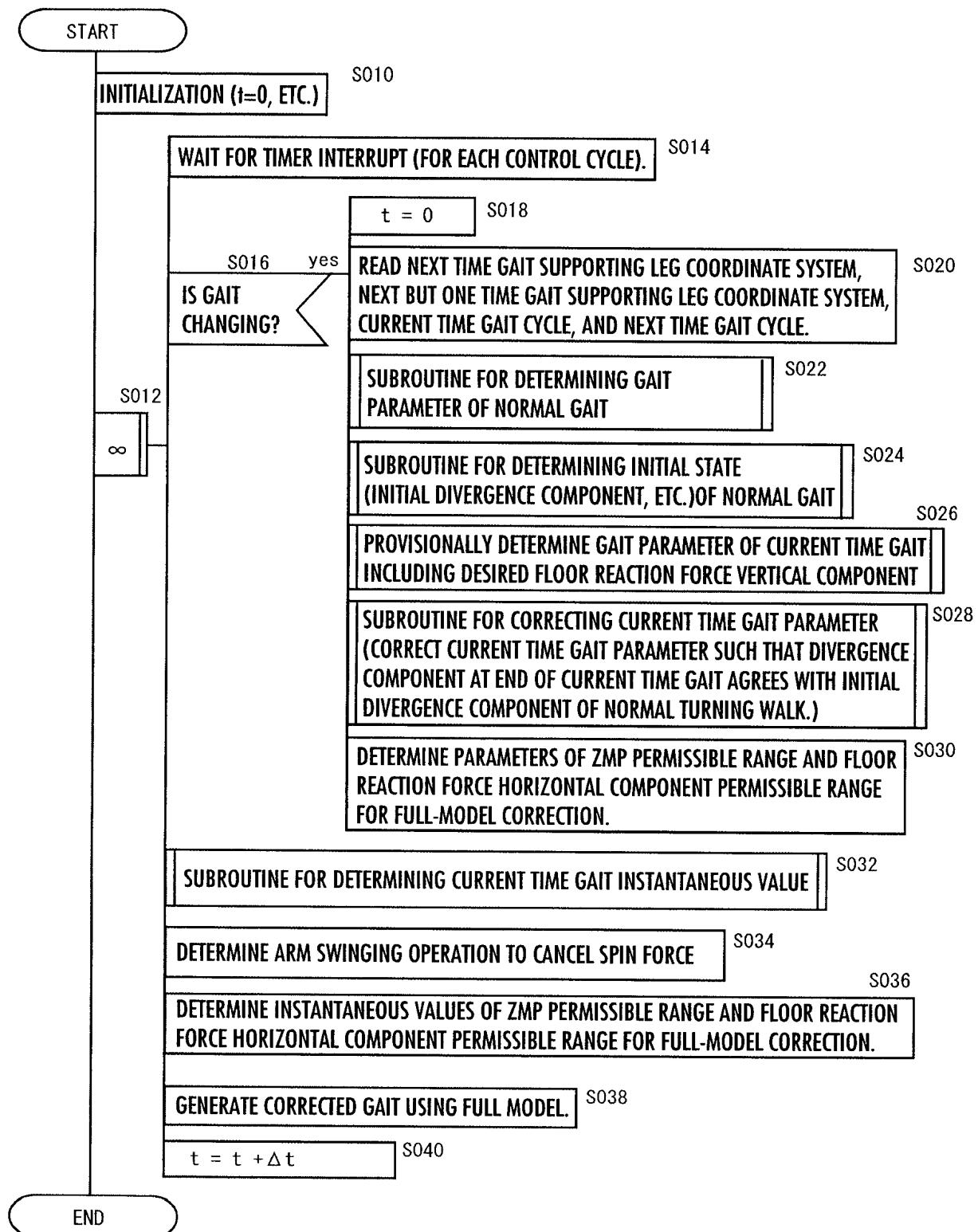
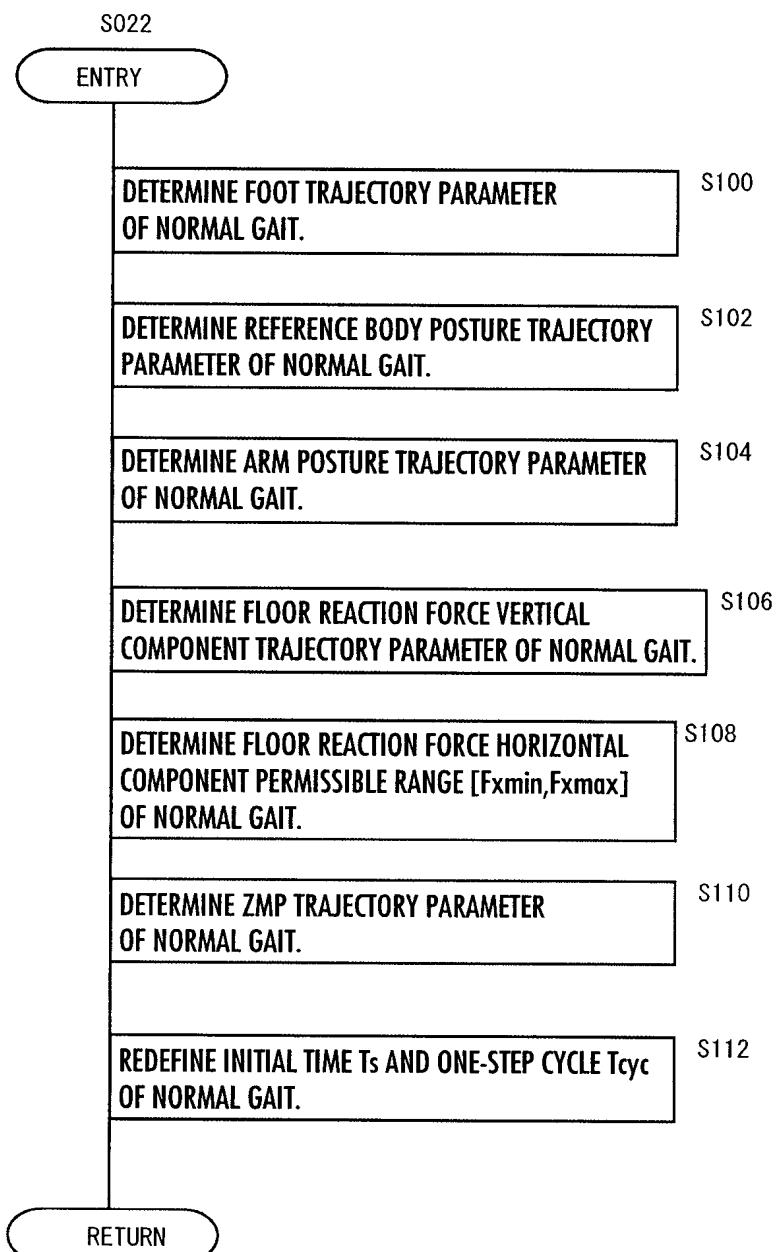
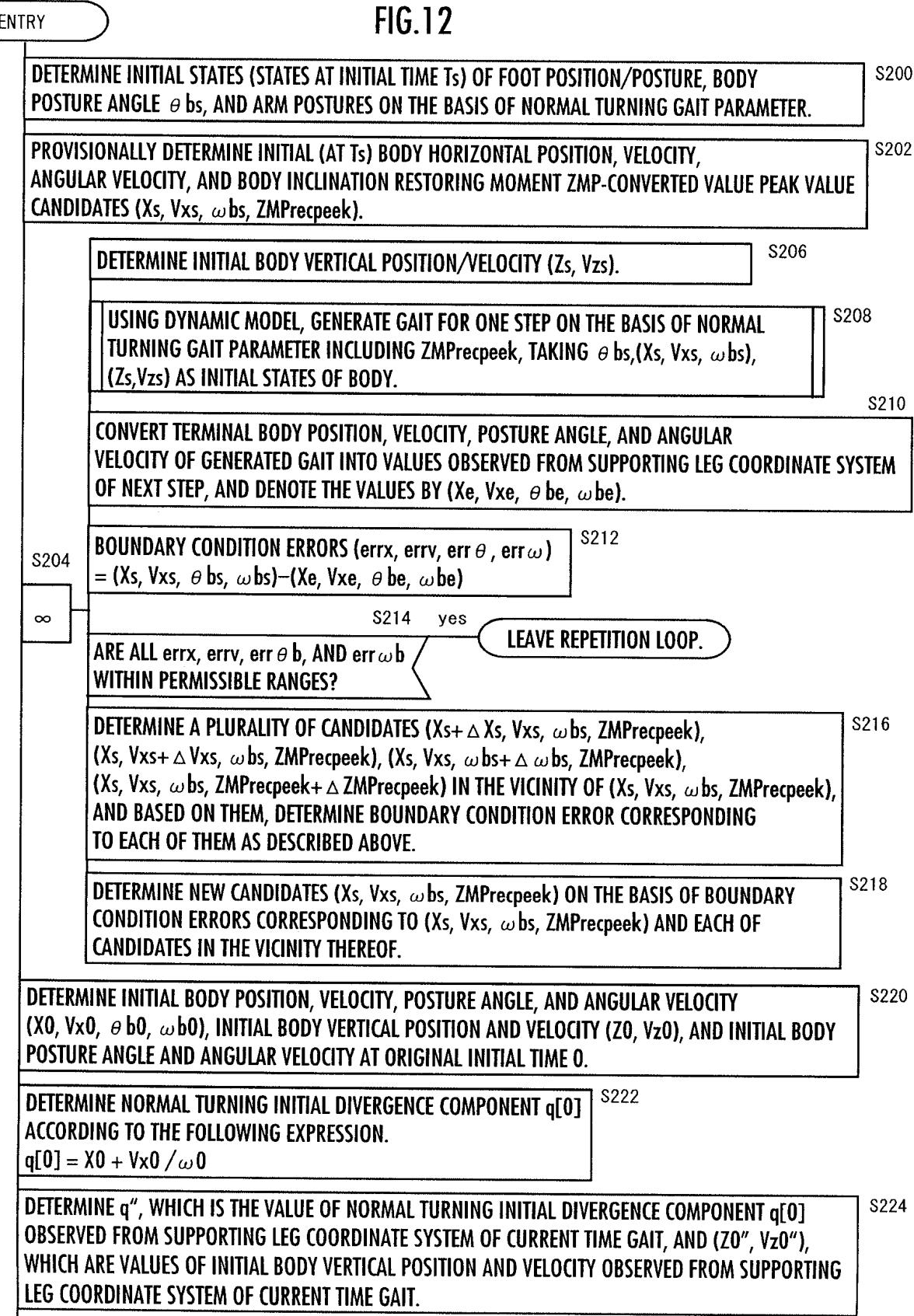


FIG.11

S024

11 / 19

FIG.12



RETURN

FIG.13

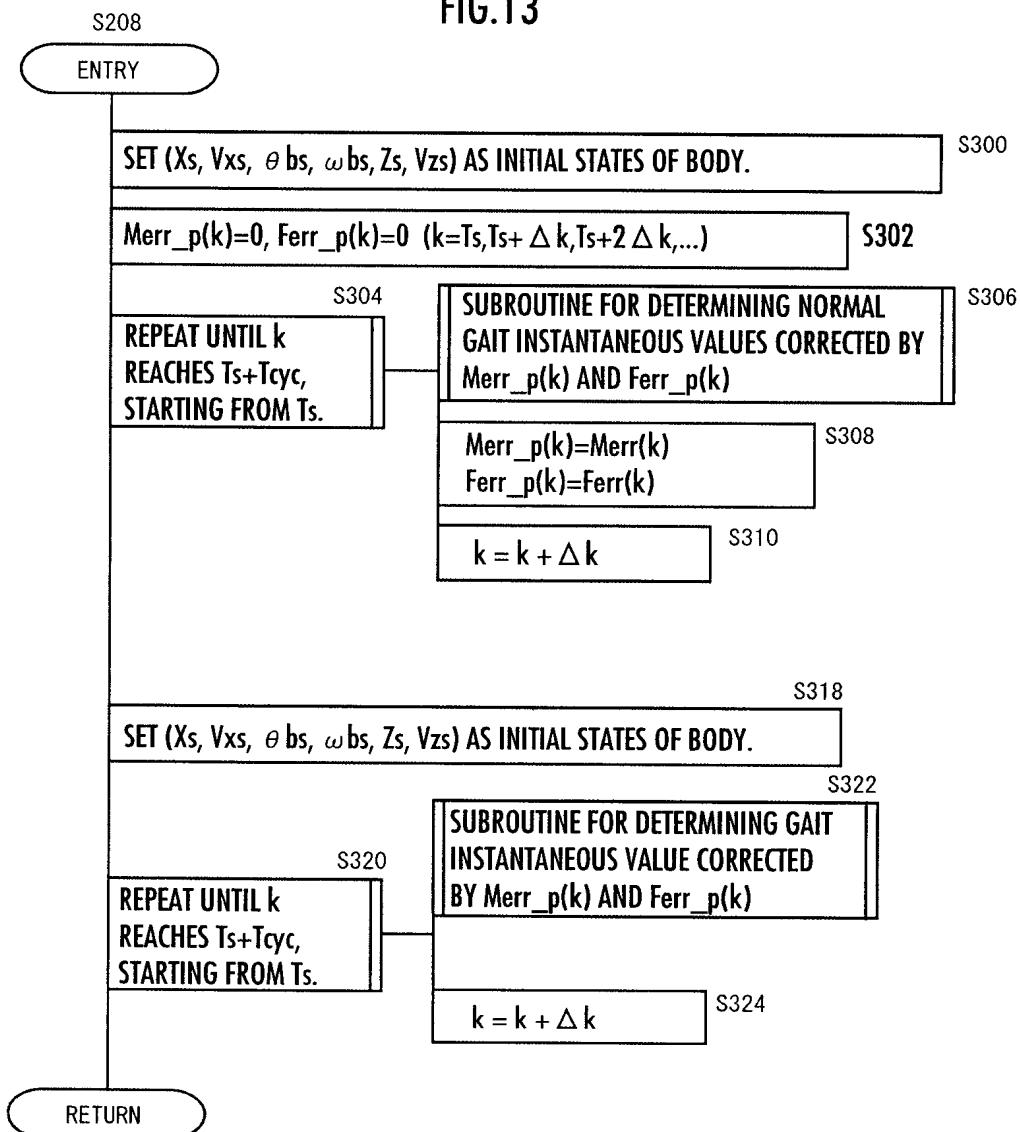


FIG.14

S306 or S322 or S032

ENTRY

DETERMINE DESIRED FLOOR REACTION FORCE VERTICAL
COMPONENT AT TIME k ON THE BASIS OF GAIT PARAMETER.

S400

DETERMINE DESIRED ZMP AT TIME k ON
THE BASIS OF GAIT PARAMETER.

S402

DETERMINE DESIRED POSITIONS/POSTURES OF BOTH FEET,
REFERENCE BODY POSTURE, AND DESIRED ARM POSTURE AT
TIME k ON THE BASIS OF GAIT PARAMETER.

S404

CALCULATE TOTAL CENTER-OF-GRAVITY VERTICAL POSITION/VELOCITY
THAT SATISFY DESIRED FLOOR REACTION FORCE VERTICAL COMPONENT.

S406

CALCULATE BODY VERTICAL POSITION SATISFYING
TOTAL CENTER-OF-GRAVITY VERTICAL POSITION.

S408

DETERMINE TRANSLATIONAL FLOOR REACTION FORCE HORIZONTAL COMPONENT
PERMISSIBLE RANGE [Fxmin, Fxmax] AT TIME k ON THE BASIS OF GAIT PARAMETER.

S410

S412

DETERMINE BODY HORIZONTAL ACCELERATION AND BODY POSTURE ANGULAR ACCELERATION
SUCH THAT -Merr_p(k) IS PRODUCED ABOUT DESIRED ZMP. DETERMINE, HOWEVER,
BODY HORIZONTAL ACCELERATION AND BODY POSTURE ANGULAR ACCELERATION SUCH THAT
VALUE OBTAINED BY ADDING Ferr_p(k) TO TRANSLATIONAL FLOOR REACTION FORCE
HORIZONTAL COMPONENT Fx DOES NOT EXCEED [Fxmin, Fxmax] AND THAT BODY POSTURE
ANGULAR ACCELERATION BASED ON ZMPrec PATTERN IS PRODUCED DURING BODY
INCLINATION ANGLE RESTORING PERIOD.

INTEGRATE BODY HORIZONTAL ACCELERATION AND BODY POSTURE ANGULAR ACCELERATION
TO CALCULATE BODY HORIZONTAL VELOCITY AND BODY POSTURE ANGULAR VELOCITY.
INTEGRATE THESE FURTHER TO DETERMINE BODY HORIZONTAL POSITION AND BODY POSTURE.

S414

S415

CALCULATE FLOOR REACTION FORCE MOMENT HORIZONTAL COMPONENT Msmp1(k) ABOUT DESIRED
ZMP AND TRANSLATIONAL FLOOR REACTION FORCE HORIZONTAL COMPONENT Fsmp1(k) AT TIME k,
WHICH ARE GENERATED ON SIMPLIFIED MODEL BY DETERMINED DESIRED MOTION.

CALCULATE FLOOR REACTION FORCE MOMENT HORIZONTAL COMPONENT Msemifull(k) ABOUT
DESIRED ZMP AND TRANSLATIONAL FLOOR REACTION FORCE HORIZONTAL COMPONENT Fsemifull(k)
AT TIME k, WHICH ARE GENERATED ON SEMI-FULL MODEL BY DETERMINED DESIRED MOTION.

S416

$$\begin{aligned} Merr(k) &= Msemifull(k) - Msmp1(k) \\ Ferr(k) &= Fsemifull(k) - Fsmp1(k) \end{aligned}$$

S418

RETURN

FIG.15

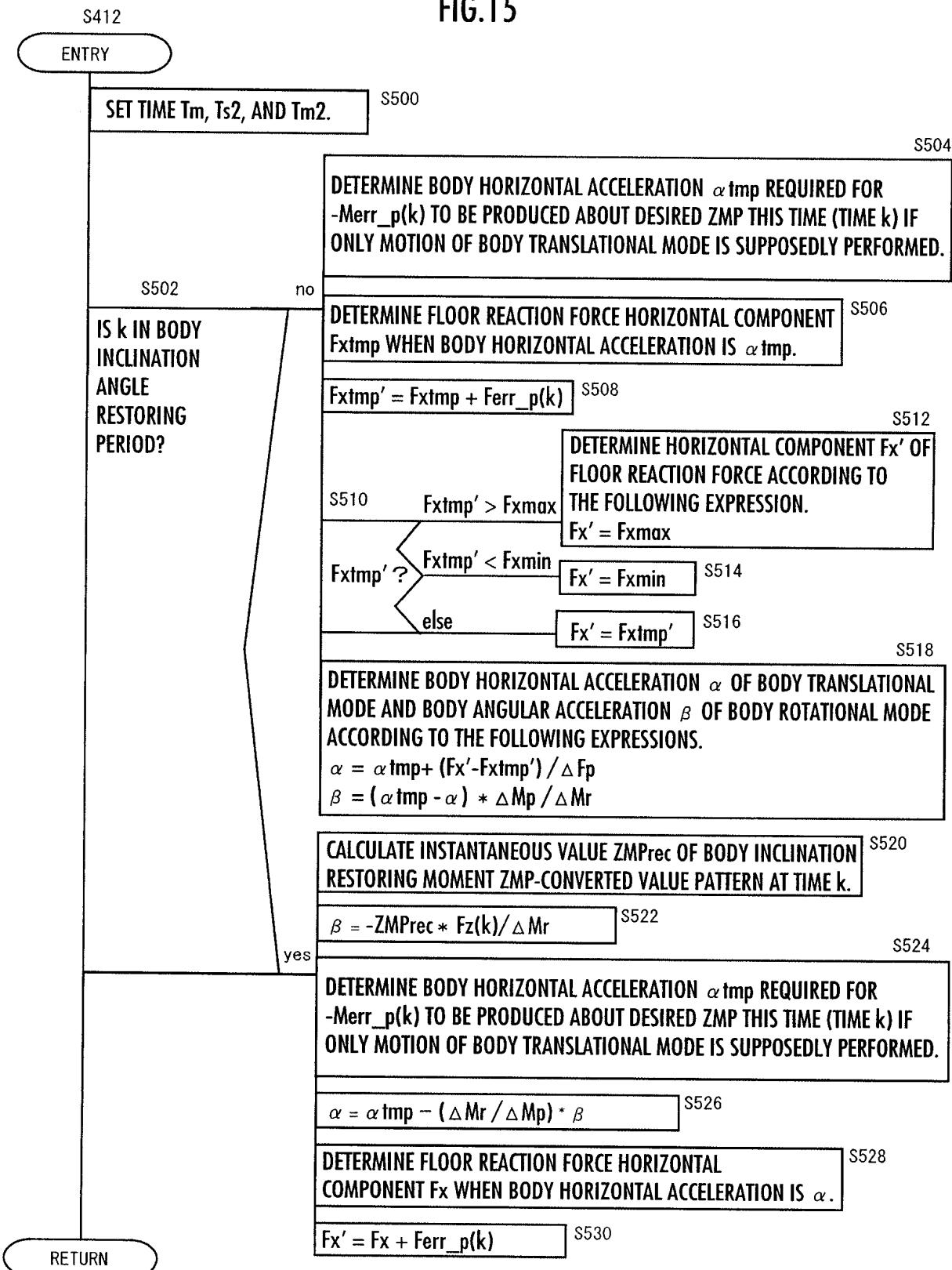


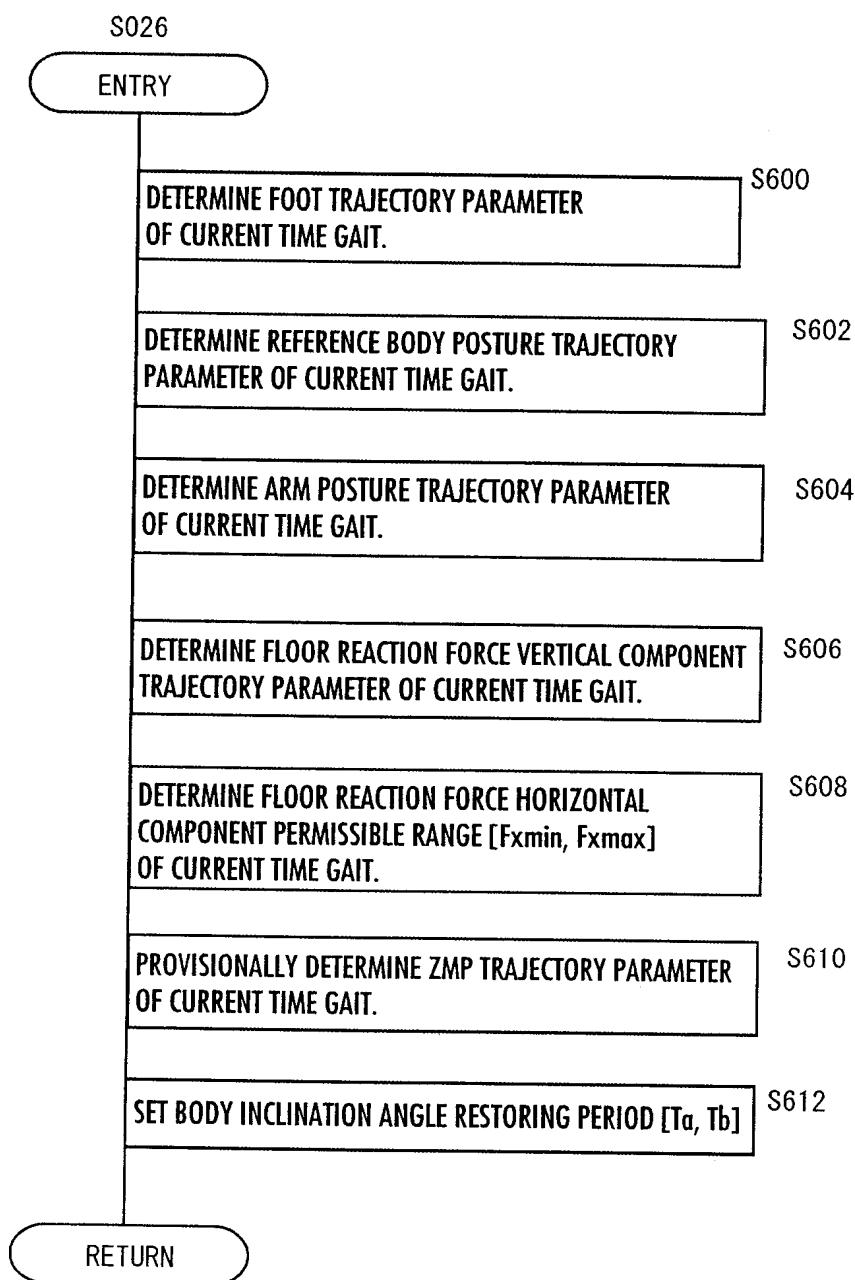
FIG.16

FIG.17

S028

ENTRY

S700

PROVISIONALLY DETERMINE ZMP CORRECTION PARAMETER CANDIDATE α AND BODY INCLINATION RESTORING MOMENT ZMP-CONVERTED VALUE PEAK VALUE CANDIDATES (ZMPrecpeeka, ZMPrecpeekb).

S704

CALCULATE PROVISIONAL CURRENT TIME GAIT UNTIL TERMINATING TIME ON THE BASIS OF PARAMETER OBTAINED BY CORRECTING ZMP PARAMETER, WHICH HAS BEEN PROVISIONALLY DETERMINED BY PROVISIONAL DETERMINATION PROCESSING OF CURRENT TIME GAIT PARAMETER, BY ZMP CORRECTION PARAMETER CANDIDATE α , BODY INCLINATION RESTORING MOMENT ZMP-CONVERTED VALUE PEAK VALUE CANDIDATES (ZMPrecpeeka, ZMPrecpeekb), AND OTHER CURRENT TIME GAIT PARAMETERS.

S706

DETERMINE TERMINAL DIVERGENCE COMPONENT $q_0[k]$ ACCORDING TO THE FOLLOWING EXPRESSION FROM BODY POSITION/VELOCITY (X_e , V_e) AT TERMINATING END OF CURRENT TIME GAIT:
 $q_0[k] = X_e + V_e / \omega_0$

S708

DETERMINE TERMINAL DIVERGENCE COMPONENT ERROR err_q ACCORDING TO THE FOLLOWING EXPRESSION:
 $err_q = q_0[k] - q''$

S710

TERMINAL BODY POSTURE ANGLE ERROR θ_{berr}
= NORMAL GAIT INITIAL BODY POSTURE ANGLE
- CURRENT TIME GAIT TERMINAL BODY POSTURE ANGLE
TERMINAL BODY POSTURE ANGULAR VELOCITY ERROR ω_{berr}
= NORMAL GAIT INITIAL BODY POSTURE ANGULAR VELOCITY
- CURRENT TIME GAIT TERMINAL BODY POSTURE ANGULAR VELOCITY

S702

 ∞

S712 yes

LEAVE REPETITION LOOP.

ARE ALL err_q , θ_{berr} , AND ω_{berr} WITHIN PERMISSIBLE RANGES?

S714

DETERMINE A PLURALITY OF CANDIDATES ($\alpha + \Delta \alpha$, ZMPrecpeeka, ZMPrecpeekb), (α , ZMPrecpeeka+ Δ ZMPrecpeeka, ZMPrecpeekb), AND (α , ZMPrecpeeka, ZMPrecpeekb+ Δ ZMPrecpeekb) IN THE VICINITY OF (α , ZMPrecpeeka, ZMPrecpeekb), AND BASED ON THEM, DETERMINE ERROR CORRESPONDING TO EACH OF THEM AS DESCRIBED ABOVE.

S716

DETERMINE NEW PARAMETER CANDIDATES (α , ZMPrecpeeka, ZMPrecpeekb) ON THE BASIS OF (α , ZMPrecpeeka, ZMPrecpeekb) AND ERROR CORRESPONDING TO EACH OF CANDIDATES IN THE VICINITY THEREOF.

RETURN

FIG.18

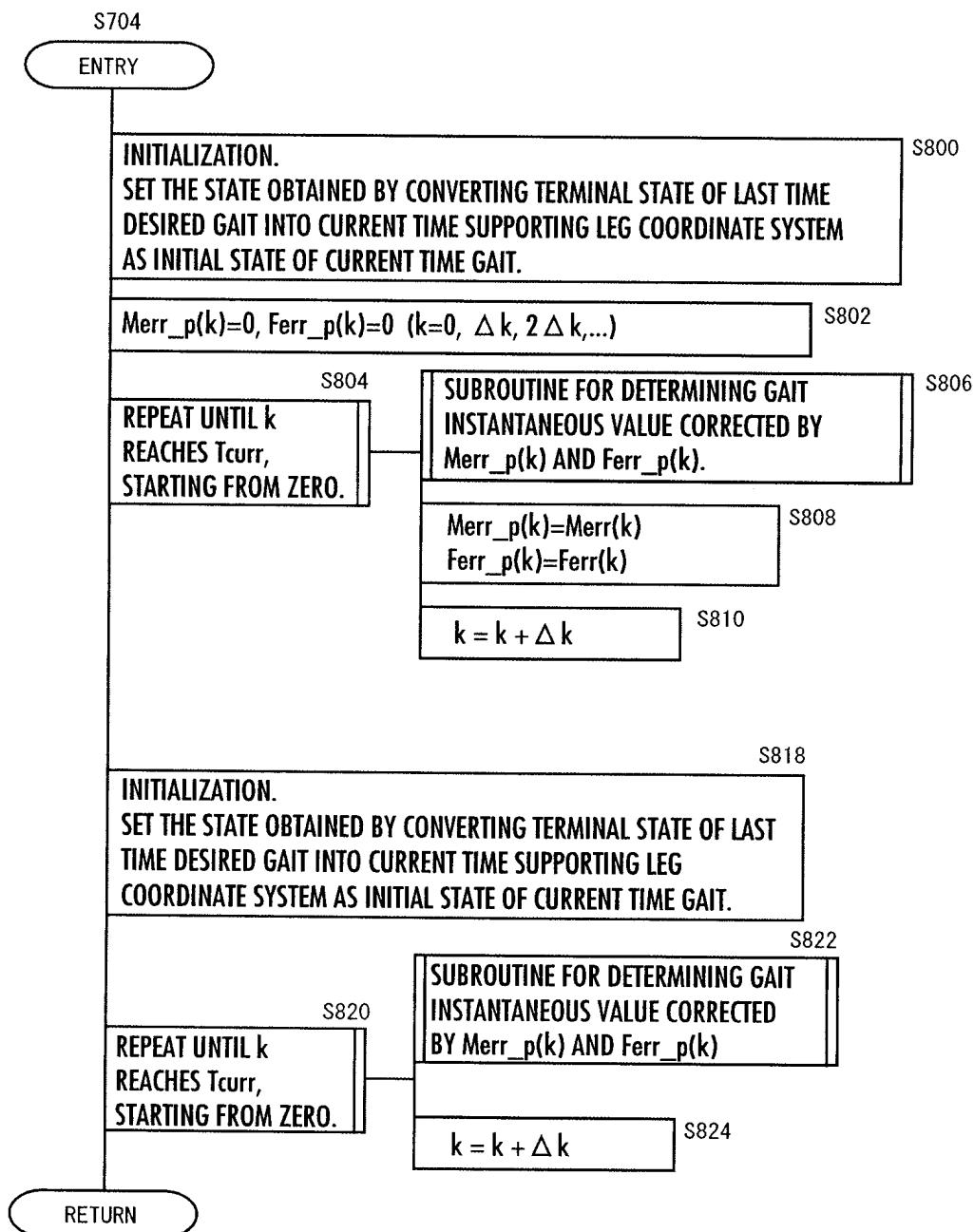


FIG.19

BODY INCLINATION RESTORING MOMENT ZMP-CONVERTED VALUE OF NORMAL GAIT (ZMPrec)

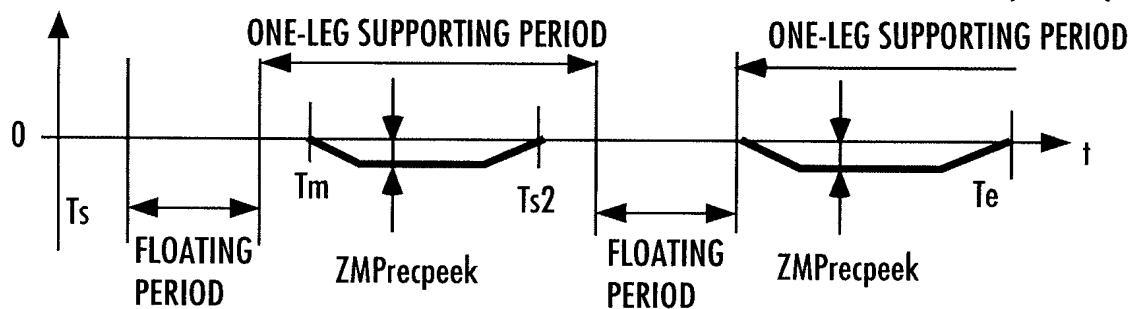


FIG.20

BODY INCLINATION RESTORING MOMENT
ZMP-CONVERTED VALUE OF CURRENT TIME GAIT (ZMPrec)

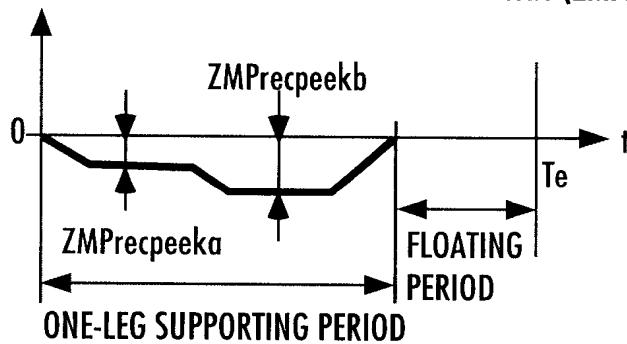


FIG.21

